THE CLAIMS

What is claimed is:

1. A method of alkylating an aliphatic or aromatic hydrocarbon with an olefin, which comprises contacting the aliphatic or aromatic hydrocarbon with the olefin in the presence of a solid polymeric onium polyhydrogen fluoride complex under conditions sufficient for the alkylation of the aliphatic or aromatic hydrocarbon.

2. The method of claim 1, wherein the aliphatic hydrocarbon is a C_4-C_{10} saturated, branched hydrocarbon.

3. The method of claim 2, wherein the olefin is a C_2-C_8 alkene.

4. The method of claim 3, wherein the alkylation of the aliphatic hydrocarbon produces a high-octane C_6-C_{12} branched alkane.

5. The method of claim 3, wherein the molar ratio of the saturated, branched hydrocarbon to the olefin ranges from about 2:1 to about 20:1.

6. The method of claim 1, wherein the aromatic hydrocarbon is a C_6-C_{20} aromatic hydrocarbon.

7. The method of claim 6, wherein the olefin is a C_2-C_{20} alkene.

8. The method of claim 7, wherein the alkylation of the aromatic hydrocarbon produces a detergent alkylate.

9. The method of claim 8, wherein the detergent alkylate is further sulfonated under conditions sufficient to produce a detergent.

10. The method of claim 1, wherein the solid polymeric onium polyhydrogen fluoride complex comprises a polymeric material containing in some or all of

its repeat units a nitrogen, phosphorus, or sulfur atom capable of forming an onium fluoride moiety upon reaction or complexation with anhydrous hydrogen fluoride.

11. The method of claim 1, wherein the solid polymeric onium polyhydrogen fluoride complex is poly(vinylpyridinium) polyhydrogen fluoride or poly(aminomethyl)styryl polyhydrogen fluoride.

12. The method of claim 1, wherein the polymeric onium polyhydrogen fluoride component comprises from about 70 to about 95 weight percent hydrogen fluoride.

13. The method of claim 1, which further comprises contacting the aliphatic or aromatic hydrocarbon with the olefin in the presence of a Lewis acid halide or a strong Bronstead acid.

14. The method of claim 13, wherein the Lewis acid halide or strong Bronstead acid is present in an amount from about 0.1 to about 10 weight percent of the solid polymeric onium polyhydrogen fluoride complex.

15. A process for forming a solid polymeric onium polyhydrogen fluoride complex, which comprises contacting a homopolymer or copolymer including, in at least one repeat unit, a nitrogen, phosphorus, or sulfur atom, capable of forming an onium fluoride moiety upon reaction or complexation with a source of hydrogen fluoride under conditions sufficient to form the solid polymeric onium polyhydrogen fluoride complex.

16. A solid polymeric onium polyhydrogen fluoride complex formed by the process of claim 15 that is capable of facilitating alkylation of an aliphatic or aromatic hydrocarbon with an olefin.

17. The process of claim 15, wherein the source of hydrogen fluoride is anhydrous hydrogen fluoride.

18. A process for removing hydrogen fluoride from an alkylation product, which comprises contacting the alkylation product with a homopolymer or copolymer including, in at least one repeat unit, a nitrogen, phosphorus, or sulfur atom, capable of forming an onium fluoride moiety upon reaction or complexation with a source of hydrogen fluoride, under conditions sufficient for the homopolymer or copolymer to complex hydrogen fluoride.

19. The process of claim 18, wherein the removal of hydrogen fluoride occurs in the absence of any aqueous or caustic treatment.

20. A method of regenerating a solid polymeric onium polyhydrogen fluoride complex useful as an alkylation catalyst, which process comprises contacting the solid polymeric onium polyhydrogen fluoride complex made by the process of claim 15 with a source of hydrogen fluoride under conditions sufficient to regenerate the solid polymeric onium polyhydrogen fluoride complex.

21. The method of claim 20, wherein the source of hydrogen fluoride is anhydrous hydrogen fluoride.